FINAL DRAFT

California Integrated Waste Management Board

Evaluation of the Northern and Southern Rubberized Asphalt Concrete Technology Centers

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SJOBERG EVASHENK CONSULTING, LLC

455 Capitol Mall•Suite 700•Sacramento, California•95814 •Tel 916.443.1300•Fax 916.443.1350

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Evaluation of the Northern and Southern California Rubberized Asphalt Concrete Technology Centers

Executive Summary

The California Integrated Waste Management Board (Board) has contracted with two counties, Los Angeles and Sacramento, to deliver services related to promoting and providing information relative to using Rubberized Asphalt Concrete (RAC) in local agency public road projects. Under terms of the agreements with the State, the two counties administer the Northern and Southern California Rubberized Asphalt Concrete Technology Centers (Technology Centers). Our review of the operations and activities of each of the two Technology Centers found that they are responsive to inquiries about RAC, provide presentations advocating RAC utilization, and have developed useful promotional handouts. Our statewide survey also reveals that local transportation officials generally know of the RAC product and its uses, and are somewhat familiar with the Technology Centers. However, we noted that both Technology Centers tend to be reactive in nature, lack strategic plans or proactive approaches to aggressively advocating the use of RAC, and need to improve their focus and motivation to fulfill their underlying missions and Board's intent for these programs. Further, while the Technology Centers have delegated certain responsibilities between the two offices and have minimized duplication of effort, we find some inconsistencies in information distributed and in standards suggested as guidance.

In our effort to identify opportunities to improve RAC program effectiveness, we also observed several impediments to using RAC that lie beyond the ability of the Technology Centers to influence and likely require the Board's intervention and assistance.

The Technology Centers offer some very positive contributions to the RAC program. Specifically, we found that they:

- Effectively respond to inquiries from local public agencies and their consultants regarding proper material testing, mix design, and construction procedures for RAC.
- Attend, exhibit, and provide presentations at tradeshows and conferences.
- Developed attractive and useful educational and informational materials conveying general and technical data advocating the use of RAC and providing benefit to public agency staff.
- Developed and maintain an Internet website providing important RAC information to the public.
- Independently operate toll-free RAC "hotlines" and appear to provide immediate and satisfactory response to inquiries.

While we found that generally the Technology Centers fulfill the Board's contract provisions, these agreements need reconsideration since the program, as currently

operating, has limited effectiveness. By revisiting the mission and intent of the Technology Centers and the existing method for program delivery, the Board could influence their overall impact and results. We also identified other areas where Technology Centers' services can improve. Specifically:

- Both centers operate in primarily a reactive mode and provide services when requested by local agency or trade association personnel. As such, the Centers' actions for advocating RAC and conveying available programs supported by the Board have minimal exposure and little participation by local government entities. In particular, we found that many individuals had knowledge of the RAC product but did not know of the Technology Centers, incentive programs, or other related services.
- Although staff from the Technology Centers attend trade conferences, deliver information, and provide advice as requested, neither Center has developed targeted, proactive outreach programs or protocols to reach other local government decision makers, RAC producers, and other non-transportation local officials. Thus, while we found that the Technology Centers have assisted in delivering the RAC message to many local transportation officials, they have yet to expand their message to other stakeholders and decision makers that must ultimately adopt positions to use RAC.
- The rebate or incentive programs established by the Board and administered by the Centers have gone largely underused. Although anecdotal discussions suggest that the rebates and associated requirements may render the programs not cost effective, the majority of survey respondents indicate little knowledge of the programs.
- Both Technology Centers fulfill the letter of their Board contract and provide knowledgeable, expert staff to undertake RAC-related activities and answer inquiries. However, because these staff work as-needed, their primary focus is not on RAC-related activities, rather their principal attention and responsibilities reside with their county duties.
- Neither of the two Technology Centers established performance measures or evaluation processes to assess the success or effectiveness of their efforts and demonstrate the value of their services. The terms of the Board's contracts with the two Technology Centers require the development of performance measures and results reporting.
- Information distributed by the two Centers is not always consistent and at times conflicts, depending upon the opinion of the individual providing the data. Thus, the two Centers do not provide a uniform presence nor consistent guidance.
- There appears to be little coordination or collaboration with Caltrans to leverage efforts to effectively increase the use of RAC in California. Not only do we note a lack of communication and focus between the Technology Centers and Caltrans' staff responsible for the use of RAC in California, but we see an untapped potential for collaboration of RAC projects geographically

that could maximize the availability and potentially decrease the cost of the product statewide.

Notwithstanding past efforts and the opportunities for operational improvements, several factors outside of the two Technology Centers' influence directly impact the accomplishment of their mission and the general promotion of RAC in California. For example, whether seated in fact or not, our survey reveals that many local government officials believe that a RAC project is more expensive than a road project composed of traditional asphalt materials. It remains unclear whether these perceptions involve considerations other than total cost, such as the extended life of RAC roadways or the public value of reduced noise afforded by the material. Further, other perceptions suggest that RAC is considered a relatively experimental product and local officials may see a "political cost" or risk to approving such projects over traditional, more proven approaches. In addition to these perceptual barriers, we found a significant materials cost differential between the northern and southern California regions—seemingly due to product availability, and volume and usage levels.

It is unclear whether the Southern California Technology Center's financial incentive programs to use RAC are underutilized because of lack of exposure or whether the rebate amounts are insufficient to influence RAC usage. Some stakeholders told us that the reimbursement rate per ton is insufficient in itself to influence a local entity to use RAC rather than conventional asphalt, particularly with the added requirement for these projects to obtain engineering certifications. Recently enacted legislation has increased the rebate amount per ton, but the program has yet to be implemented; thus, we could not determine the impact of the increased rebate amount. Finally, we find that some California crumb rubber producers use tires imported from other states and countries—an economic decision that runs contrary to the Board's intent to promote RAC as an environmentally friendly way to offset California's burgeoning used tire problem within the solid waste stream.

Recommendations

The Technology Centers should:

- Act more as an advocate for RAC—be proactive in searching for opportunities to promote the use of RAC.
- In concert with the Board, develop an overall strategic plan for the two centers that includes specific goals and objectives and detailed action plans for each Center for delivering services and meeting the program goals and objectives.
- Develop outreach tools specific to Technology Centers' services and rebate programs.
- Consider options for greater staff resource commitment to the Technology Centers; alternatives may include using retired annuitants, limited-term hiring, one-year full-time appointments with return rights to the county position, or contracting with an outside vendor.

- Develop benchmarks and performance measures and a process to track and link efforts to the measures.
- Establish formal processes for coordinating efforts and sharing information between the two Technology Centers.
- Initiate a collaborative relationship with Caltrans at the headquarters and field office level with the goal of leveraging resources and affording local agencies greater access to RAC.
- Continue to reexamine the target audience to ensure current and future asphalt decision makers are receiving needed services and promotional information.
- Develop additional outreach tools such as newsletters or electronic communication to local officials and other stakeholders with RAC updates and issues (include links to website and other relevant and pertinent information).
- Ensure that Center representatives and collateral materials and guidelines convey consistent messages and broadly promote the RAC product rather than promote a particular application process.
- Develop standardized quarterly reporting to the Board that ties efforts with performance measures and that allocates time and expenses to the appropriate task line item.

Furthermore, the Board should consider:

- Examining the delivery method of the Technology Centers. Options to consider should include:
  - Requiring both Los Angeles and Sacramento County to devote a full-time individual to the related Center. This can be achieved through a temporary one-year assignment from county duties with return rights to the former position; through hiring a limited-term employee; or contracting with a retired annuitant.
  - Continuing the Technology Centers at a reduced level having one of both of them under contract to maintain and operate the website, toll-free telephone lines, provide collateral materials, administer the rebate/incentive programs, and other of the reactive services. In concert with the Centers' activities, contract directly with an individual expert in the field to have the primary responsibility for advocating RAC statewide. That individual should work with the Board to develop a strategic plan for outreach and demonstration projects, providing numerous presentations to reach the various levels of decision makers and stakeholders.
  - Absorbing the operations of the Technology Centers into Board functions and hiring on a two-year (or other reasonable time period) limited-term basis former local government or industry experts to undertake a full-time RAC advocacy and information outreach and service program.

- In operating the Technology Centers in the current form, the Board should consider:
  - Continuing to support Technology Centers' efforts to develop RAC performance and cost data that will provide local jurisdictions evidence of the costs and benefits of using RAC.
  - Instituting a program for local area demonstration projects where Center staff work directly with local government agencies on a RAC application. In working directly with selected local governments to partner in demonstration projects, the Board could provide publicity, advocate the product, demonstrate RAC benefits, exhibit tangible results, educate potential users and decision makers, and afford success stories.
- Monitoring and assessing the use and response to incentive and rebate programs for using RAC to determine the most reasonable and attractive package for participation.
- Developing a program to either train local authorities to inspect RAC projects or provide inspection services to local jurisdictions to ensure the proper application of RAC and the success of projects.
- Collaborating with producers to make RAC more available and affordable.
- Assisting the Technology Centers in developing a collaborative relationship with Caltrans and for leveraging the State's position in making RAC more available and attractive to public works authorities.
- Establishing guidelines and incentives for RAC producers and users to use only California tires for their crumb mixes.

Introduction

In cooperative efforts, beginning in 1997 with the County of Los Angeles, and later, in 2000, with the County of Sacramento, the California Integrated Waste Management Board (Board), established two Rubberized Asphalt Concrete Technology Centers (Technology Centers). Located in both Los Angeles and Sacramento counties, the aim of the Technology Centers is to promote the use of crumb rubber from scrap tires in roadway rehabilitation projects. The Board's intent in funding these Technology Centers is to provide local governments with education, training and consulting services to advocate the use of Rubberized Asphalt Concrete (RAC) and to increase its use in California.

Senate Bill 876
(Chapter 838, Statutes of 2000)

Required the Board to have a five-year plan for the Waste Tire Recycling Management Program that would:

- Reduce the stockpiles of tires in the landfills.
- Provide for funding of RAC promotion through June 2008 at a level of $600,000 per fiscal year.

The Board believes the use of RAC by local governments represents the single largest potential for growth in its use. This is important since California is faced with the challenge of diverting or safely managing more than 33 million reusable and waste tires generated in the state each year. Recognizing this fact, the Board, in its *Five-Year Plan for the Waste Tire Recycling Management Program, 2nd Edition* (Five-Year Plan) has endorsed the concept of continued funding of RAC promotion through June 2008 at a level of $600,000 per fiscal year. To this point, the Board has relied primarily on the Technology Centers to implement its program and to act as an advocate for RAC in California.

What is RAC?

RAC is a concrete product composed of used tires, ground into crumb rubber and blended with asphalt. One of the principal advantages of RAC is the recycling of waste tires, thus helping to manage the yearly flow of waste tires and thereby reducing California's growing stockpile of waste tires and preserving landfill space. Specifically, a two-inch RAC resurfacing project uses over 2,000 waste tires per lane mile. The reported advantages of RAC include:

- Cost effectiveness compared to conventional asphalt—using RAC may allow for reduced overlay thickness thus requiring less material. Using reduced thickness in a roadway project could generate a savings of as much as $22,000 per lane mile over conventional asphalt. Road projects paved with RAC have longer wear life than traditional asphalt concrete projects.
- High skid-resistance, reduction in road noise, and resistance to cracking, shoving, and rutting if a gap-graded mix is used.
- Durable surface and long-lasting color contrast for striping and marking.

Producers use three processes to add crumb rubber to asphalt concrete to make RAC: the

Wet Process, the Dry Process, and the Terminal Blend Process. Specifications for all three processes are included in the *Greenbook, 2000 Edition, Standard Specifications for Public Works Construction*, a publication produced by Public Works Standards, Inc. Generally, the three RAC processes differ in the timing of introducing ingredients into the mixture, the mixing process, the composition of the mixture.

The Wet Process

In California, the Wet Process is the most common method used to add crumb rubber to asphalt concrete. It has the longest history of use and is the basis for Caltrans' reduced thickness design. In this process, a special blending unit is required. The RAC is mixed at the asphalt plant where prepared cement binder is heated and crumb rubber added to the heated mixture—crumb rubber comprising approximately 20 percent of the resulting asphalt binder—then the aggregate materials are added. The fully mixed material must be maintained in a heated silo and transported in heated asphalt trucks. For best results, the material should be maintained at a set temperature. The plant requires little notice for blending the material.

Summary of RAC Processes

Wet Process—The crumb rubber is blended with the hot asphalt cement binder prior to adding the aggregate material. This process requires specialized equipment at the asphalt plant.

Dry Process—This method mixes the crumb rubber with the aggregates prior to the addition of the asphalt. The process does not require specialized equipment.

Terminal Blend Process—A patented process whereby all raw materials are mixed simultaneously at a refinery. The fully mixed material is stored at an asphalt plant while awaiting transport to the job site.

The Dry Process

The Dry Process does not require special blending units and is mixed at the asphalt plant. At the plant, the rubberized crumb material is melted and the aggregate is added; the cement binder mixture is then blended into the crumb rubber—like the Wet Process, crumb rubber comprises approximately 20 percent of the resulting mixture. Similar to the material that is created through the Wet Process, Dry Process RAC must be stored in heated silos and transported in heated asphalt trucks. Dry Process RAC is mixed on demand and does not require significant pre-notification for production.

The Terminal Blend Process

The Terminal Blend Process, which has been used in Texas since 1995, uses less crumb rubber than the other two processes (comprising 10 percent of the resulting asphalt material). This process, formerly known as the Refinery Process, is primarily conducted at an oil refinery. Specifically, unlike the other two methods, the Terminal Blend process heats and mixes all components of the material simultaneously—the components of the cement binder have not been premixed as in the other two methods. The fully mixed material is transported from the refinery to the asphalt plant where it is stored in heated silos until the heated asphalt trucks transports the material to the construction site. Users of Terminal Blend RAC must order the material 2 to 3 days in advance.

All three of the RAC processes differ from traditional asphalt used by public works agencies in road refurbishment projects in terms of RAC's sensitivity to temperature. As a result, RAC application may require additional equipment to more quickly place the material to avoid setting problems or to sand the roadway to make it available faster for use.

Technology Center Structure

Over the years, Los Angeles and Sacramento counties became significant users of RAC and were recognized as leaders in the use of this product—as such, the Board selected the two counties to lead the local government efforts by establishing the Technology Centers.

Southern Technology Center

In 1996, the Los Angeles County Public Works Department's pavement-testing lab contacted the Board regarding the possible funding of a county program to disseminate information about RAC to public works agencies throughout the state. As a result of these efforts, the Board executed a $500,000 contract with the County of Los Angeles in April 1997, thus establishing a statewide Technology Center.

Since its inception, county public works employees have staffed the Southern Technology Center on a part-time basis. The Technology Center's program director is the Public Works Department's assistant deputy director. The program director's involvement is generally limited to attending periodic Board meetings and reviewing both status reports provided to the Board and RAC incentive letters awarded to public agencies. These activities consume, on average, about one hour per week. Additionally, one public works employee is designated the responsibility to respond to technical questions and attend workshops, conferences, and seminars, devoting about 4 hours a week performing these duties. The Technology Center's program coordinator—a county lab assistant—contributes the most involvement in the day-to-day activities: fielding inquires from the toll-free phone calls and e-mails and forwarding the technical issues to the appropriate party; making travel arrangements and preparing materials for RAC conferences or seminars, and monitoring and managing the RAC web site. These duties usually involve approximately 10 to15 hours per week. Overall, with additional County staff assistance, the activities of the Technology Center consume approximately 90 hours a month.

Northern Technology Center

Around 1999, Sacramento County was approached to establish a Technology Center administered by the Sacramento public works department. According to the Technology Center's program director, the benefit of creating a Northern Technology Center was to target RAC promotional efforts in the northern region—an area where it was significantly more costly to use RAC than in the southern California region. It was thought that increased use of RAC would help stabilize the price of RAC and in turn reduce the risk to local government in trying RAC for the first time. These discussions resulted in a

$320,000 contract between the Board and the County of Sacramento in January 2000.

Like the Southern Technology Center, county public works employees also staff the Northern Technology Center on a part-time basis. The program director, a County principal civil engineer, describes his Technology Center related work as being seasonal and estimates that he spends approximately 4 to 6 hours a month performing activities to fulfill the terms and scope of the contract. His time increases during periods where he conducts workshop presentations, participates in trade shows, and works on informational materials (e.g. promotional colored brochure, Rubber Design and Construction Guidelines). Additionally, two other public works employees occasionally assist with some of the administrative duties or fill-in with technical expertise.

Technology Centers' Contract Provisions and Activities

As previously noted, public works officials from Los Angeles and Sacramento County entered into separate contracts with the Board to establish and maintain the two centers. Los Angeles County signed the first agreement with the Board—over the last seven years since inception, three contracts were executed with three amendments to support the Southern Technology Center.

Contract 1 – Southern Technology Center

An 18-month agreement (June 1, 1997 to November 30, 1998) totaling $500,000 generally included the following requirements:

- Consult with local public agencies regarding proper material testing, mix design and construction procedures for RAC; provide effectiveness data for RAC projects; and, offer laboratory assistance to cities without labs to ensure initial RAC projects are successful. ($300,000)
- Provide statewide outreach training programs with a focus on technology transfer in both laboratory and field environment. ($100,000)
- Provide a knowledgeable contact to disseminate RAC information. ($37,500)
- Develop educational and informational materials for RAC to be made available to local government officials. ($25,000)
- Institute a RAC Internet Web Site. ($17,500)
- Update the Board with quarterly status reports and assistance records including assistance provided, who was assisted, project type and size, and any outcomes or follow-ups. ($15,000)
- Develop a process to assess the value of the services provided by the Technology Center. ($5,000) Measures include:
    a) Overall quality of service
    b) Knowledge of staff to answer questions
    c) Quality of information provided, written and verbal

d) Timeliness of response

The funds for this contract were not fully expended and this agreement was amended to extend its provisions to May 14, 1999.

Contract 2 – Southern Technology Center

A second two-year contract running from May 1998 through May 2000 totaling $500,000 was executed in May 1998; provisions of this contract ran concurrent with those of Contract 1 above and introduced two incentive programs:

- Pavement deflection testing—Payments up to $5,000 per RAC project to fund preliminary engineering costs determining whether a project is suitable for RAC.
- Quality Assurance/Quality Control (QA/QC)—Reimbursements of $1.00 per ton on RAC projects (not to exceed $10,000) and requiring a quality assurance inspection to insure a successful project.

In February 2000, the second contract was amended in three significant ways. First, the amendment eliminated provisions that offered the county's laboratory services because Los Angeles County was concerned about the liability of providing laboratory services for others and the consumption of the funding by small cities for services not offered to others. Second, the amendment increased funding by $200,000, making the total contract $700,000. Third, the amendment extended the contract period one year through May 2001. Contract 2 was amended again to extend the contract period through December 2001.

Contract 3 – Southern Technology Center

The third and latest contract between the Board and the County of Los Angeles was executed in January 2002 and included $450,000 to fund calendar years 2002 and 2003. The scope of services remained similar to previous contracts with the exception of the termination of the pavement deflection testing incentive program.

Contract 1 – Northern Technology Center

In January 2000, Sacramento County executed a contract with the Board to establish the Northern Technology Center that included $320,000 in funding for the period of one calendar year. The scope of the responsibilities was similar to those initially established for the Southern Technology Center with two additional responsibilities:

- Implementing a county funding and rebate program ($125,000) –
    - A program intended to provide for a combined RAC material contract that could potentially lower and stabilize the cost of RAC to local agencies in Northern California.
    - RAC Rebate program – provides for determining the amount of RAC

tonnage used under the combined materials contract and prorating a rebate not to exceed $1.50 per ton, with priority for rebate given to first-time RAC users. (It is our understanding that this county funding and rebate program was not implemented by either Technology Center.)

- Investigating the feasibility of RAC Blender Unit for use in Northern California. ($15,000)

Similar to the Southern Technology Center, the contract's budget was not fully expended so the Board amended the agreement though calendar year 2001 and amended it again in December 2001 to run through May 2002.

Contract 2 – Northern Technology Center

The second contract between the Board and Sacramento County covers activities for the two fiscal years 2001-2002 and 2002-2003 and included another $450,000 in funding. The scope of services were similar to the prior contract but also included a new provision targeting $200,000 of the center's budget for research projects demonstrating RAC's effectiveness.

Scope and Methodology

The California Integrated Waste Management Board (Board) contracted with Sjoberg Evashenk Consulting, LLC to evaluate the Northern and Southern California Rubberized Asphalt Concrete Technology Centers.

As part of our contract with the Board, we were directed to:

1. Review documents that contain the criteria against which these Technology Centers will be measured, and develop the evaluation methodology;
2. Review and document allocations of funds and funds expended by the two Technology Centers during their entire history;
3. Perform a process evaluation of the Technology Centers;
4. Perform an outcomes evaluation of the Technology Centers;
5. Conduct a survey of local government transportation departments to determine their knowledge and perceptions of RAC, their needs regarding expertise in RAC, and appropriate incentives or assistance that will encourage them to use RAC in pavement projects;
6. Prepare a final report and present information from tasks, findings, and recommendations to the Board at specified meetings, workshops, and/or Waste Tire Conferences.

To locate where these specific tasks are covered within the body of this report, a schedule at Appendix D provides a crosswalk for each task to the page number and section where that particular task is addressed.

To accomplish these specific task requirements, we requested from the Board background information related to each of the Technology Centers including Board minutes and agenda items, Waste Tire Management Program Annual Reports, prior RAC studies, and other related Board documents.

Additionally, we researched and reviewed Waste Tire Management Program legislation, including Assembly Bill 117, Escutia (Chapter 1020, Statutes of 1998), Senate Bill 876, Escutia (Chapter 838, Statutes of 2000), and Senate Bill 1346, Kuehl (Chapter 671, Statute of 2002). We also tracked pending legislation including Assembly Bill 338 (Levine).

Moreover, we conducted detailed interviews with current and former Technology Center staff, related county staff, CIWMB Board Member and staff, Caltrans officials, and other RAC stakeholders such as RAC producers, pavement associations, and local public officials to better understand the Technology Centers' programs, activities, outreach efforts, and influence.

To understand the terms and scope of services that were contractually provided by the Technology Centers, we reviewed each of the contractual agreements and related

amendments between the Board and Los Angeles and Sacramento County officials. We reviewed Technology Centers' expenditures, collected available allocation detail for each Center since their inceptions, and reviewed invoices. We compared total expenditures to budget task items and ascertained why funds were unspent. Additionally, we examined resources used by the Technology Centers to accomplish program goals and objectives and performed an analysis of categories of expenses based on allowable costs as determined by the provisions of the contracts

To learn about the Technology Centers' activities, we reviewed their website, toll free phone and email logs, educational/informational materials, and some prepared seminar presentations. Additionally, we reviewed RAC research projects initiated by the Technology Centers and identified key steps and decision points in their staff decision-making processes. Because of limited RAC usage data, we contacted the Technology Centers' consultant hired to collect that information to determine when it would be complete and available to the public. We also researched other resources to determine the level of RAC usage in California.

In examining Technology Center performance, we reviewed progress reports submitted to the Board and any available data demonstrating efforts or performance maintained by the Centers including workshop attendance rolls and conference surveys. We also researched, contacted, and interviewed RAC consultants and officials both in California and other states including Arizona, Texas and South Carolina.

Further, we developed a contact list of over 900 stakeholders relevant to RAC at the local government level (see separate document containing this listing). Based on this listing, we developed and distributed a 39-question, Board-approved, survey of local government transportation departments to determine their knowledge and perceptions of RAC and the Technology Centers. We initially sent 746 surveys via e-mail and another 156 by facsimile. Our initial response after two weeks was very low from the e-mail group and adequate from the facsimile group. We again e-mailed the survey to all 746 recipients with a request to complete in two weeks. Again we received a very small response. After directly contacting a few potential respondents, we found that due to recent Internet problems with viruses and spam, many individuals no longer open documents from unknown sources. Therefore, we went through the arduous process of obtaining fax numbers and faxing another 100 surveys to former e-mail recipients. Ultimately, after many attempts we achieved a 16 percent response rate to our survey. We later removed from our survey results 28 responses from producers, contractors, and consultants to limit our data to local agencies – the target audience of the technology Centers, for a final response rate of 13 percent. Results of our survey can be found in Appendices A and C.

We also sent a second survey out to 25 individuals who had responded to our original survey asking them to evaluate the effectiveness of the Technology Centers' educational and informational materials. Because of the volume of information, we first contacted these individuals by telephone and asked them to participate; we received full responses from 12 reviewers. Results of this survey are in Appendix C.

Chapter 1

The Technology Centers Generally Fulfill Contract Requirements but a More Proactive Approach Could Increase Their Effectiveness

Our review of the operations and activities at each of the two Technology Centers reveals that they generally fulfill the provisions of their contracts with the California Integrated Waste Management Board (Board). The Technology Centers are responsive to inquiries about RAC, provide presentations advocating RAC utilization, and have developed useful informational RAC handouts. Our statewide survey of public transportation stakeholders discloses that local public works officials generally know of the RAC product and its uses and are somewhat familiar with the Technology Centers. However, while both Technology Centers generally provide the services stipulated in the contracts, the focus of the State's contract and their efforts should be reconsidered to maximize the potential and effectiveness of the RAC programs.

As presently operated, the Technology Centers are reactive in nature, responding to requests and inquiries. Whereas contract provisions set duties to provide consulting services and outreach, neither center has taken a truly proactive approach nor developed strategic plans to meet the underlying mission and goals of the programs. Further, despite requirements to do so, neither center developed or maintained performance measures to demonstrate the outcomes of their efforts or their success in affecting the use of RAC at the local level. Additionally, by design, the Technology Centers function using "borrowed" county staff—clearly those individuals providing their services to the centers offer the requisite expertise and experience, yet their principal responsibilities reside with their county positions; as such, their primary attention is not devoted to Technology Center activities. Without a refocusing of the Technology Centers' operations to assist the Board in fulfilling its primary missions, adopt and implement strategic plans, and establish performance measures to achieve desired outcomes, the Centers have limited ability to further influence the use of RAC at the local level.

Technology Centers Provide Valuable RAC Information

During our evaluation, we found the Technology Centers' staff appear to effectively respond to inquiries from local public agencies conveying valuable program and technical information such as the proper methods for testing material, mix designs, and construction procedures for RAC. We found the centers' utilize resources including telephone, Internet, presentation, and collateral materials to inform interested parties about RAC. For example, the two Technology Centers provide on-site consultation and visits—typically, those involving local agencies north of San Luis Obispo County are handled by the Northern Technology Center and those to the south by staff from the Southern Technology Center. Most on-site technical consulting is requested by local agencies to assist them in their deliberations as to the feasibility of using RAC on either a specific project or in general. The Technology Center staff provide technical insight as to

the feasibility of using RAC, the application options available, construction processes, and the possible benefits derived from the product.

Our evaluation discloses that both of the Technology Centers' primary coordinators offer significant experience and technical expertise in pavement design. Specifically, the Northern Technology Center program director is a licensed civil engineer with 17 years experience with the Sacramento Department of Transportation and is the vice president of the Sacramento Chapter of the American Public Works Association. Furthermore, the Southern Technology Center technical expert is a licensed civil engineer and brings 22 years of experience in the Los Angeles County Public Works road maintenance, design, and construction divisions. He is also the chairman of the Special Provisions Guide Subcommittee of the Greenbook Committee—the "Greenbook" being one authoritative resource for road construction commonly used nationwide.

To obtain opinions and perceptions of the effectiveness of the Technology Centers, we conducted a comprehensive survey of local government transportation officials and other stakeholders statewide. We surveyed 902 local government managers, contractors, and producers—after repeated attempts to obtain responses and removal of 28 responses from non-target audiences, we achieved nearly a 13 percent response rate (please see Scope and Methodology section of this report). From these responses, the results appear compelling and informative. Overall, 92 percent of our respondents say they are familiar with RAC with nearly 50 percent indicating they are very familiar with the product.

However, while our survey revealed that far less than half of the respondents know of the existence of the Technology Centers, the vast majority of the respondents—72 percent—indicate that they are not familiar with the services the two Centers provide; further less than 30 percent say they have had contact with the Centers. Of those knowing about the Technology Centers, most found out about them through workshops, seminars, or from collateral materials (brochures or pamphlets).

Of the respondents saying they have had contact with the Centers, 78 percent noted that in requesting help that the Centers were "very helpful" –giving a rating of 4 or 5 on our 5-point scale. Moreover, of those participants that sought help, 85 percent found staff at the Centers "very knowledgeable" or ranking them 4 or 5 on our scale.

Additionally, 46 percent of respondents requesting assistance from the Centers stated that help was provided immediately, with another 23 percent saying the Centers responded within three working days of the request. The survey suggests that on a few occasions assistance took from 7 to 14 days.

On-site Consulting and Workshops

Both northern and southern Technology Center technical staff conducted on-site demonstrations and workshops at individual agencies. Additionally, these staff also gave presentations at industry conferences such as the Rubber Pavements Association and Asphalt Pavement Association. Also, the Southern Technology Center personnel staffed

information booths at several agency association conferences, such as the League of California Cities and California State Association of Counties. Typically, the Northern Technology Center program director or the Southern Technology Center civil engineer conduct the on-site demonstrations and workshops and give presentations at association-sponsored conferences. Other staff may also attend these functions including the Southern Technology Center program coordinator or materials engineer. Although the Centers participated in a number of these events, it is unclear as to the impact of their contribution to increasing awareness and use of RAC in the state. In fact, our survey found that when asked what more the state can do to promote RAC, 25 percent of our respondents indicated that the State should provide more RAC education.

Collateral Materials

In addition to attending public works and transportation tradeshows and conferences, we found that the Technology Centers also created and distribute collateral materials to educate and inform potential users of the benefits of RAC. Specifically, the Northern California Center developed two RAC informational booklets and two field inspection workbook/guides. The information booklets include an overview of the Technology Center program, describing the services offered as well as benefits of RAC. The second informational booklet is the *Asphalt Rubber Design and Construction Guideline*; this booklet includes technical information on RAC design, construction, economics, and related benefits or limitations. In addition, the Northern Technology Center also produced the *Field Guide for the Construction Inspector* and an accompanying workbook. All of these materials are shared and distributed by both the northern and southern Centers but are paid from allocations to the Northern Technology Center.

In order to assess the usefulness and adequacy of the information presented in the collateral materials and to ascertain whether these documents motivate local government to consider using RAC, we conducted a second, specifically targeted survey issued to 25 individuals responding to our first survey. We obtained comprehensive responses from 12 of these selected local government managers. Their responses overwhelmingly convey that they found the Technology Centers' overview booklet to be "useful" or "clear" with many respondents stating that it was "very useful or "very clear". Further, all respondents indicated that the booklet was at least "compelling" to use or find out more information about RAC, with 75 percent describing it as "more than compelling". The survey results for the more technical design guideline booklet indicate that all respondents believed the booklet to be at least "good" providing technical information, with the clear majority describing it as either "very good" or "excellent".

Toll-free Numbers and Web Communication

In addition to on-site consulting, and conference exhibiting and programs, both Technology Centers operate toll free and local hotlines operating from the desks of program staff. The Southern California Center maintains a formal telephone log of calls received. The staff at the Southern California Center indicated the volume of calls to average around 40 per month. In Northern California, the process is more informal;

staff do not maintain a log but our review of contemporaneous notations and of an individually-maintained telephone book suggest dozens of contacts over the period of operation. The Northern Technology Center program manager estimates he receives approximately one to two calls per week—about half being technical in nature. Yet, our survey indicates approximately 15 percent of respondents have had contact with the Centers by telephone.

Further, as required under the Board's contract, the Centers also operate a website and offer contact through e-mail. We found that the Technology Centers' were successful in creating a useful and educational California RAC website, located at "www.rubberizedasphalt.org". This website contains an abundance of resource information, such as:

- RAC history
- Technical information and guidelines
- Advantages of RAC
- Rebate/Incentive program information and forms
- Questions & Answers section
- Locations of Seminars & Workshops
- Cost Comparisons
- Producers, Contractors, Consultants contact information
- Agency Contacts

However, of the 115 respondents to our Technology Center services survey, 84 percent indicate that they had not visited the website. Of those that had visited the website, a clear majority (90 percent) found the website easy to locate and navigate. Further, most had not reviewed the results of research projects funded by the Technology Centers that are included on the website. Additionally, interviews with the Northern Technology Center's Director indicated that a number of phone calls originate outside of California and may be indicative that the website address is not sufficiently California-specific. He suggests that changing the website address to be something reflecting a California RAC target may attract more of its intended audience.

Additionally, we found that the Technology Centers informational e-mail address (info@rubberizedasphalt.org) links directly to the Southern Technology Center program coordinator. The Program Coordinator reviews all e-mail correspondence and responds directly to those inquiries or forwards them to a more appropriate resource, such as a Los Angeles County civil engineer or to the Northern Technology Center if the issue is of a regional nature.

While the Technology Centers appear effective in communicating RAC information, we noted that most collateral materials, conferences, and inquiries involve local government managers involved in day-to-day transportation public works projects; thus, these efforts

may not be reaching the individuals ultimately responsible for deciding on RAC for public works projects. Specifically, we are told that conferences where Technology Center personnel exhibit or present may often have too many rank and file staff and few, if any, representatives that make the final decisions on RAC projects. Another concern recently raised by the Southern Technology Center staff deals with statewide conferences (such as the League of California Cities and the California State Association of Counties). At these venues, the Technology Centers' display is treated similar to any other for-profit vendor and does not garner consideration as being a government agency. Not only are the out-of-pocket exhibit costs expensive at these conferences, but also the amount of hours necessary to staff the booths.

However, it appears the Technology Centers are beginning to find more beneficial ways to promote RAC at these conferences. For example, at recent conferences, the Southern Technology Center has seen significantly greater benefit by being a conference presenter as opposed to an exhibitor. According to Southern Technology Center staff, at a Fresno conference in November sponsored jointly by Rubber Pavements Association and the Technology Centers, there was a much higher level of interest in RAC following the presentations than exhibiting at previous conferences.

The Technology Centers' Reactive Approach Limits the Program's Effectiveness

The Board established required tasks and deliverables in its contracts with each of the Technology Centers. Generally, as conveyed earlier in this chapter, we found that the Centers provided most of those services. However, in reviewing the contracts and assessing the Technology Centers' activities since inception, we believe that the contract provisions are being narrowly interpreted and, as such, Center staff services as called upon rather than proactively defining and planning the efforts necessary to make a true difference toward increasing RAC usage statewide. As an example, one of the central programs offered through the Technology Centers is a rebate for using RAC; nearly 35 percent of our survey respondents who commented on this program element indicated no knowledge of such a program. The Centers' reactive rather than proactive approach to conducting RAC-related activities is an area of weakness in the Technology Centers' delivery of the Board's program.

We find several issues influencing the delivery of services by the Technology Centers. Although the contracts require an assessment measuring the value of services provided at each Center in terms of quality of service and materials, knowledge of staff, and timeliness of responses (we will discuss performance measures later in this chapter) the contracts do not require strategic or action plans with goals and objectives to guide the efforts of the two Centers to achieve the Board's underlying program purpose of increasing the use of RAC statewide. Additionally, the inherent design of the Technology Centers as extended resources of the two counties' public works departments with "borrowed" staff has resulted in the RAC program activities having to fit into the primary responsibilities of staff as needed. Further, while the two Centers strive to coordinate activities, we found some inconsistency between the Centers in the tone

and content of the RAC messages and a nearly non-existent relationship between the Centers and Caltrans. All of these factors impact the success of each of the Technology Centers.

Center Personnel Expertise and Experience

Generally, our evaluation finds that the Technology Centers provide valuable information—while this may be loosely defined as outreach, most of the information and technical advice is delivered upon request; staff the Technology Centers with qualified, knowledgeable personnel; develop and deliver educational and informational materials; and they operate a website. However, as the results of our survey reflect, most respondents say that their interaction with the Technology Centers occurred at workshops or conferences or were initiated by the local agency; supporting our assessment that the Centers' activities are primarily reactive. Only 41 percent of our respondents were familiar of the Technology Centers and of that group of 115, only 28 were familiar with the services they provided. Additionally, of the 72 respondents initiating RAC projects, only 18 indicated that the Technology Centers had some role in providing information or assistance to that project.

Brochures and other Technology Center resources state "the rubberized asphalt concrete technology center promotes the use of crumb rubber from scrap tires in roadway rehabilitation projects by providing education and training to local public agencies throughout California without charge." We found that the Centers generally aligned their activities toward this vision and to fulfill most of the contract provisions. However, neither site had created specific goals and objectives, or proactive action plans for meeting the full intent of the program and each of the contract provisions. Although the contract provisions specify the level of funding allocated for each task and responsibility, we found that neither Center developed or defined the underlying scope and tasks required, set a schedule, or created individual budgets for the line items. We believe the challenging task of increasing the use of RAC by local governments statewide is unlikely to be achieved through simply providing presentations to a few associations, conducting requested workshops, or sending out information when asked.

In order to achieve their intended purposes, each Technology Center should be required to develop strategic plans including setting goals and objectives and action items to maximize the limited funding available for this program. Though a deliberate plan, the Technology Centers should be able to proactively reach the essential local agency decision makers and provide compelling data and assistance to positively influence the perception of RAC. Similarly, planning and delivering regional informational sessions in conjunction with producers and other stakeholders would allow the Technology Centers to leverage their skills, knowledge, and resources. Advocating RAC and delivering and pressing the message to the various levels of stakeholders will generate interest in the Technology Centers' other resources in terms of training, technical advice, and program assistance and could provide a positive impact on the use of RAC statewide.

In developing the Technology Center program, the Board determined that because State

employees were not available to staff the program and that because these services were to be aimed at and provided to local government, the best providers of the program would be a local agency with extensive experience using the RAC product. As a result, the Board sought out local entities with experience and expertise in RAC projects and selected Los Angeles County as the entity to provide the services. Having a history using RAC, the critical internal staff expertise and depth of knowledge, and the size to absorb additional duties, Los Angeles County agreed to the contract. The Board's contracts with Los Angeles and Sacramento County are built on a reimbursement basis for staff time and materials.

Technology Centers Operate Part-Time

Each of the Technology Centers are staffed part-time with County employees having other County-related responsibilities associated with their permanent, full-time positions. This staffing structure does not commit staff resources at a particular level and other county-related commitments may not permit Technology Center staff the time necessary to actively conduct RAC-related activities on a consistent and continuous basis. For example, at the Northern Technology Center only the program director contributes any significant time towards the Center's activities—spending on average approximately 13 hours per month.

Similarly, the Southern Technology Center, while spending considerably more time on Center efforts, contributed three staff members who combined spent about 158 hours per month through the duration of the first contract with the Board—this is equivalent to approximately one full time employee per month. During the second contract period, Southern Technology Center staff spent approximately half as many hours on Center activities—averaging a combined 93 hours per month. This second contract having an initial duration of 17 months was amended to add an additional 15 months to the agreement. For the most part, we found that only one staff member worked on Technology Center-related activities during this period.

An indicator that the Technology Centers were not realizing their full potential is the fact that the contracts for both Centers required amendments—not for additional funding in most cases, but to extend the contract periods to continue the availability of unspent funds. For example, under the first agreement with the Board, the Northern Technology Center was given 12 months to spend $320,000. Of the $320,000, slightly less than $57,000 was spent within the initial contract period, which represents about 18 percent of the contract. After receiving a 12-month extension from the Board, the Northern Technology Center billed just over $50,000, bringing the total amount invoiced to almost $107,000 or 34 percent of the total contract. Finally, the Board gave the Northern Technology Center a final extension of 4 ½ months—at the time of the expiration of the last extension only $215,000 or 68 percent of the original $320,000 contract budget had been invoiced by the Northern Technology Center.

Under the current contracts and program operational structure, neither Center fully consumed its funding resources before the agreement period ended. For the contract term

ending December 31, 2003, the Southern Technology Center consumed approximately 57 percent of its contract. Significantly, only about 95 hours per month were devoted to Center activities—comprising approximately .55 of a full time equivalent position. However, with a two-year budget of $250,000 for outreach and technical assistance, at an average hourly billing rate of $89.42, over 88 percent of the outreach and technical assistance budget was consumed. Of further note, due to the underutilization of the "QC/QA Incentive Program" only 17.5 percent of its $200,000 budget has been consumed—rebating only $35,000 during the two-year period. Early in the Technical Center programs, staff in the Southern Technology Center committed far more time to Center activities than in the more recent periods. Like the Northern Technology Center, the first contract was not consumed—allocating $500,000 over an 18-month period toward labor driven activities, even using the highest billing rate of $89 per an hour, labor hours would need to reach 312 per month to consume the original contract within the agreement period. In the second contract for the Southern Technology Center, although the County contributed fewer labor hours during the original and amended contract period, the agreement's allocation was also reduced; thus, expenditures more closely matched the budget for labor hours.

The Northern Technology Center for the two-year period ending December 31, 2003 was allocated $450,000—$250,000 to outreach, technical assistance, and website development and $200,000 for research. At the end of the contract term, only $120,561 was charged against the contract. However, this amount does not include the expenses related to the RAC database project, which is due for completion in the winter of 2004. According to the Director of the Northern Technology Center, the center had not invoiced the Board for this project prior to the contract expiring. We also found the Northern Technology Center did not invoice the Board designating costs to specific contract tasks, instead the invoices were itemized to specific county cost center categories.

Technology Centers Operate Independently

The service delivery model appears to have another weakness—both Technology Centers operate autonomously—essentially run by different governmental entities. Moreover, each Technology Center "personality" is set by the lead staff assigned. Whereas both Centers have very competent, experienced, and knowledgeable leaders, they each have their own preferences and opinions. As a result, we found that at times the two Centers convey inconsistent RAC messages.

For example, the Northern Technology Center is a proponent of the Wet Process for the RAC product. The Wet Process is oldest and most "tried and true" formula with a history of favorable performance. It is also the process that is specified by the Caltrans Design Guidelines as appropriate for a Reduced Thickness Overlay. However, we found that the Southern Technology Center advocates all three processes, which is consistent with the message conveyed in the Technology Centers' informational brochures. All three methods are used nationally and it is the Southern Technology Center's view that in considering projects, all three processes should be considered and the most appropriate and available method for the situation should be chosen. Moreover, since the Wet

Process requires close proximity to the processing plant and may not be as available or practical as one of the other processes, advocating only the Wet Process may discourage local agencies from using RAC at all and thus opt to use Conventional Asphalt Concrete. While the other two forms of the product lack the same level of history as the Wet Process, both are used in Southern California and show success. In terms of total use, however, RAC made using the Terminal Blend and the Dry Processes are used less often in Southern California than RAC made using the Wet Process.

The Northern Technology Center director supported his preference to the Wet Process with the fact that it is the only process specified in the Caltrans Design Guidelines for the Reduced Thickness Overlay. Further, he contends that the Wet Process also has a longer history than the other two processes. At the Southern Technology Center, a technical advisor stated that his one goal with the Technology Center is to get more tires used for paving roads. He is concerned that advocating only the Wet Process over the other two could lead some agencies to opt against using RAC due to project cost, since the Wet Process is the most expensive of the three product options. Whereas the mission of the two Centers is to advocate the use of RAC and to provide education and technical advice, it seems incongruous that the two centers would disseminate inconsistent messages and advice that may dissuade the use of RAC.

Moreover, while it is understandable that the two Centers work independently of one another since they are operated by separate local agencies, coordination and collaboration of their activities seems essential. We found that the two Centers have split some of the more significant activities—the Northern Technical Center has contracted for a special study of the usage of RAC statewide and the Southern Technical Center has developed the collateral materials, maintains the website, and administers the incentive programs. Further, they have geographically separated responsibilities related to on-site consulting and share duties for attending conferences and making presentations. Yet, there is little interaction between the two Centers and collaboration seems limited to dividing up general duties.

Technology Centers' Coordination with Caltrans

We also found that despite the fact that both the Technology Centers and Caltrans officials have essentially the same goal of using RAC when feasible, there are no collaborative efforts to combine the knowledge and expertise for a coordinated effort. An example of this is the Board's approval last year of a contract with Caltrans to educate its various district office directors on the values and uses of RAC. To meet the objectives of this contract, Caltrans contracted with the same firm, MACTEC, that was also hired by the Northern Technology Center to complete two other RAC-related projects. Unfortunately, neither of the Technology Centers nor Caltrans sought to establish a dialogue or share information and experiences relative to the values of RAC. In fact, only during our recent discussions with the Centers and Caltrans did they become aware of the similarity of their objectives.

We believe significant opportunities exist for collaboration between the Technology

Centers and Caltrans, not only in terms of RAC information sharing but in terms of potential leveraging of resources. Caltrans has twelve large regional offices located throughout the state and undertakes substantial highway projects—thus, likely to influence RAC availability, location of asphalt producers, and cost of the material. By collaborating with Caltrans, the Centers may be able to leverage the State's buying power to make RAC materials more available and logistically possible to local agencies than currently exists, particularly in the northern California region.

Thus, the Technology Centers could increase their effectiveness by putting their efforts together in a more strategic manner, ensuring the messages are consistent and frequent, by sharing tips, resources, and information, and together, collaborating with Caltrans.

Assessing Technology Centers' Results is Difficult as the Centers Have Not Developed or Tracked Their Performance

Although each Center's first contract with the Board specified the establishment of measures to assess their performance and their service to local agency constituents, neither has developed measures, benchmarked RAC activity or use, or conducted required surveys of stakeholders. Contracts executed by both Technology Centers indicate that they were to develop and distribute survey instruments to assess "customer satisfaction" and the level of service provided to the jurisdictions they serve.

The areas that the evaluations would include were specified by the Board as:

- Overall quality of service
- Knowledge of staff to answer questions
- Quality of information provided
- Timeliness of response

According to both Technology Centers and the Board, the evaluation portion of the contracts was not accomplished by Northern Technology Center and partially accomplished by the Southern Technology Center. Specifically, while we found that the Southern Technology Center did track telephone calls, e-mails, and website hits, and maintained general records of conferences, meetings, presentations, and on-site consultations—this information did not include the necessary detail such as the number of people attending, or the types of services provided to capture the level and magnitude of outreach conducted. The Northern Technology Center did not formally track telephone or other contracts, nor did it maintain any detail or records of activities. Although both Centers provided us anecdotal stories of a particular success or event of merit, neither could link actual results to their efforts. Both Centers invoiced the Board based upon labor hours consumed and did not maintain supporting information in terms of category of activity. Moreover, even if the Technology Centers had tracked their efforts (or inputs), without developing measures upon which to assess the outcomes and results of these efforts they could not assess the value of the services or whether their efforts contributed to meeting the Board's goals.

Since performance measures were not established, we looked for data that would provide some indication of the Technology Centers' performance. At the Southern Technology Center, we found that their staff had issued two small performance evaluation surveys. The survey was mailed to certain stakeholders contacted by the Southern Technology Center prior to May 1999. The second survey was distributed to participants of a Southern Technology Center workshop. While the results of both of these surveys suggest general satisfaction with the services or information provided, the scope of these reviews was limited.

We also reviewed progress reports submitted by the Centers to the Board. Reports from the Northern Technology Center lacked detail or description of specific activities completed during the period and information that was provided in the reports varied by period. For example, we found that the Center supplied data related to a workshop hosted in the East San Francisco Bay Area—listing agencies attending but not attendance numbers or specifics related to individuals. Further, the Center did not have supporting information such as a sign-in sheet or listing of individual attendees that would indicate the level of exposure afforded by the session. Additionally, although progress reports identified agencies receiving technical assistance from the Northern Technology Center by telephone, e-mail, or in person, the report did not include nor could the Center provide dates of contact or the results of the interaction. We also noted that the Northern Technology Center submitted semi-annual progress reports although the contract required quarterly reporting to the Board.

Conversely, we did find that the Southern Technology Center provided the Board with either monthly or bi-monthly summaries of activities during the term of its first contract. Additionally, the Southern Technology Center typically attached documentation, such as a contact summary sheet (describing the nature of the phone call), a copy of the correspondence to local agencies, or flyers related to workshops or conferences attended during the period of the report. However, during the periods covered by subsequent contracts, we found progress report information far less detailed, complete, and timely as provided in the first contract periods.

Additionally, the Technology Centers did not have nor could we locate benchmark or trend information relative to the use of RAC in California. This data is essential in attempting to correlate any increase in RAC usage to the efforts of the Technology Centers. We understand that the Board and the Technology Centers recognized this absence of critical information, and note that in September 2002 the Northern Technology Center entered into an agreement with a consulting firm, MACTEC, to create a public works RAC project database and annually update this information. The project is expected to be complete during the winter of 2004 and, once complete, will reside on the Technology Centers' website for public reference.

One of the primary goals of the database is to provide a resource for RAC project information including local agency contacts to interested neighboring jurisdictions and first-time RAC users. The project involved surveying local agencies to obtain project-specific information to populate the database. This database should not only serve as a

resource for local jurisdictions but will also assist the Board and the Technology Centers to track the use and type of RAC applied statewide on an ongoing basis. Data provided could also be used as baseline data for assessing Technology Center impact or effectiveness.

Our survey, while not affording a direct correlation to the Technology Centers' efforts, reveals that 92 percent of respondents were familiar with RAC and of these, the most (57 percent) common way they became familiar was through their direct involvement in a RAC project. Of those participants that were directly involved with constructing a project using RAC material, 72 percent were from the southern counties of the state including San Luis Obispo, Kern, San Bernardino, Los Angeles and all points south.

Technology Centers' Charges to the Board Contracts Appear Consistent and Allowable but Not Always Fully Supported

As described in an earlier section, the Technology Centers provided a number of the services envisioned under their contracts with the Board. Our review of invoices reveals that contract charges could be traced to supporting time sheets, travel claims, or vendor invoices. We also noted that the fiscal data used to create the Technology Centers' invoices was generated from their respective County's billing systems—which provided some additional assurance of the reliability of the information.

Additionally, we found that expenditures displayed on the invoices from both Technology Centers generally appear to match the task activities required in their respective contracts. None of the invoices suggested that expenditures charged relate to activities outside of the scope of the contract. However, regarding the Northern Technology Center, we found that the first contract with the Board required the Center to prepare a feasibility report to the Board on the merits of a competitively bid RAC production contract with cities and counties in the region. This envisioned combined materials contract—which was never conducted—was to be used as a volume purchase vehicle by local agencies to effectively reduce the cost of RAC. Another provision established a rebate program for those local entities participating in the combined materials contract adding a prorated rebate up to $1.50 per ton on RAC used under the contract. According to Board staff, the Northern Technology Center did not incur charges against these line items.

Moreover, the Northern Technology Center's contract specified certain levels of spending for designated items, such as the local rebate program and stipulated budgets for consultation, outreach, technical assistance, surveys and other duties geared technical expertise. However, neither the invoices nor supporting documentation supplied by the Center provided clear delineation of charges related to these tasks. It is likely, therefore, that some line items for the Northern Technology Center were overspent—for example, using the process of elimination, knowing that the feasibility report and the rebate program were never implemented, we see that other line items must have been overspent and some funds allocated for this program were used for other purposes. Our

conversations with the Center's program director found that he uses only one code for all costs associated to the Technology Center.

The Southern Technology Center did track their costs by contract task; however, it sometimes exceeded amounts allocated for certain tasks. For example, the Center invoiced the Board during the second contract period for approximately $16,000 more than the allocated for a particular task. While the net result was that the invoiced amount remained within the contract amount limits, the Center over-spent individual line items in some cases.

Conclusions and Recommendations

Our review of the operations and activities of each of the two Technology Centers found that they are reactive in nature and provide services as requested rather than on a proactive basis. While we found that the two Centers provide valuable information, conduct presentations or exhibit at conferences, and have developed useful promotional handouts advocating RAC utilization, their efforts fall short of meeting the goals and intent of the Board's programs. We noted that both Technology Centers tend to be reactive in nature, lack strategic plans or proactive approaches to aggressively advocating the use of RAC, and have not dedicated the staff time or attention needed to focus and deliver the services necessary to fulfill the underlying missions of the contracts. Further, while the Technology Centers have delegated certain responsibilities between the two offices and have minimized duplication of effort, we find some inconsistencies in information provided and in standards suggested as guidance.

While we found that generally the Technology Centers fulfill the Board's contract provisions, these agreements need reconsideration since the program, as currently operating, has limited effectiveness. By revisiting the mission and intent of the Technology Centers and the existing method for program delivery, the Board could utilize and leverage these resources to improve the overall impact and results.

Recommendations

The Board should consider alternative methods for delivering the local agency RAC programs. For example, the Board could continue one of both of the Technology Centers, focusing their services on established services and reactive measures such as maintaining and updating the website, responding to telephone calls and emails, providing collateral materials, providing expert consulting. In concert with the Technical Centers' scaled down responsibilities, the Board could directly hire or contract (or contract through the Technical Centers) for an expert consultant or retired public works official to work full time on developing a marketing approach for advocating RAC, coordinating and conducting demonstration projects with local agencies, partnering with Caltrans, conducting aggressive outreach to users and decision-makers, and working directly with RAC producers to increase material availability and lowering the price.

Additionally, to improve existing operations, the Technology Centers should:

- Act more as an advocate for RAC—be proactive in searching for opportunities to promote the use of RAC.
- In concert with the Board, develop an overall strategic plan for the two centers that includes specific goals and objectives and detailed action plans for each Center for delivering services and meeting the program goals and objectives.
- Develop benchmarks and performance measures and a process to track and link efforts to the measures.
- Consider options for greater staff resource commitment to the Technology Centers; alternatives may include using retired annuitants, limited-term hiring, one-year full-time appointments with return rights to the county position, or contracting with an outside vendor.
- Establish formal processes for coordinating efforts and sharing information between the two Technology Centers.
- Initiate a collaborative relationship with Caltrans at the headquarters and field office level with the goal of leveraging resources and affording local agencies greater access RAC.
- Continue to reexamine the target audience to ensure current and future asphalt decision makers are receiving needed services and promotional information.
- Develop additional outreach tools such as newsletters or electronic communication to local officials and other stakeholders with RAC updates and issues (include links to website and other relevant and pertinent information).
- Insure that Center representatives and collateral materials and guidelines convey consistent messages and broadly promote the RAC product rather than promote a particular application process.
- Develop standardized quarterly reporting to the Board that ties efforts with performance measures and that allocates time and expenses to the appropriate task line item.

Chapter 2

Board Involvement in Certain RAC Promotion Aspects Could Assist in Making the Technology Centers More Effective

Notwithstanding the efforts of the Technology Centers, many factors that directly impact the use of RAC are outside of the Centers' control, but the California Integrated Waste Management Board (Board) may be able to mitigate some of these issues to increase the use of RAC statewide. We identified several issues that influence RAC usage and the recycling of California waste tires—such as availability and cost of the RAC material; ineffective incentive programs; perceptions by stakeholders that the material is too costly or still unproven; and the importation of crumb rubber undermining the use of California's waste tires. Specifically, there are insufficient producers of RAC in the northern California region. We are told that its vast geography and disbursed population limit the demand for RAC, which in turn decreases the number of producers, and likely increases the cost of the material.

Additionally, the Southern Technology Center's current incentive program to provide $1.50 per ton reimbursement has not effectively enticed users to try RAC. Whereas, recently chaptered legislation has created a new grant program to be administered by the Board that increased the reimbursement amount to $2.50 per ton, it is unclear whether the higher rebate amount will provide enough financial incentive to switch from conventional asphalt pavement. Furthermore, we find there is still a fundamental underlying belief that RAC is generally more costly than traditional asphalt. Moreover, early failures with the product still resonate within the local transportation community and local decision makers may be reluctant to use the material due to perceived political vulnerability. Lastly, California is not gaining the full benefit of RAC usage as it appears that some RAC producers are using non-California tires for the crumb rubber mix. Without Board assistance in these areas, the use of RAC may never be fully realized in California regardless of the efforts of the Technology Centers.

Cost and Availability of RAC in Northern California

The State has been aware of the cost differential of RAC between the northern and southern California regions since around 1999. In fact, this price instability is identified in the first contract between the Board and the County of Sacramento as a primary reason for establishing the Northern Technology Center. Staff from the two Technology Centers convey that the price of RAC in Northern California is approximately 25 to 38 percent higher than in the southern region. Several contributing factors for this dramatic price difference were cited in our discussions with Technology Center staff, producers, and consultants. Population density, distance between significant population centers, and lower demand were mentioned. However, most agree that one solution for the most populated areas of Northern California would be through increased usage by all forms of government.

According to League of California Cities, there are 478 incorporated cities in the State of California. Of the largest 100 cities in California (Populations of 71,000 or greater), 68 are located in Southern California. Because of the higher concentration of larger local agencies in Southern California there are more producers and, thus, increased supply and availability of RAC.

The immediate "sphere of influence" of the two counties in which the Technology Centers are located also should not be overlooked. According to the California State Association of Counties, Los Angeles County has nearly 10 million total residents and the largest counties neighboring it are Orange County (2.9 million), San Bernardino County (1.7 million), and Riverside County (1.6 million). In contrast, there are 1.2 million residents in Sacramento County and its three largest neighbors are San Joaquin County (596,000 residents), Placer County (265,000), and Yolo County (176,000). Thus, the four largest counties around and including Los Angeles County represent approximately 16 million residents. In total, Sacramento County and its three largest neighboring counties contain only 2.2 million residents. With the Southern California region having a dramatically larger population base, more roads, and larger road projects in turn has much greater potential for higher demand for RAC; where there is volume, usage, and demand, there will be more RAC producers.

Our survey respondents from Northern California cited the cost and availability of RAC most often as being the greatest issue related to increasing the use of RAC in the region.

Many Perceive the Cost of RAC Is Higher Than Conventional Asphalt Concrete

According to technical advisors from both Technology Centers, the price of RAC per ton, regardless of the process used, is at least 20 percent more expensive than conventional Asphalt Concrete (AC). While this is true when comparing the material ton-to-ton, experts claim that the extended life of the RAC material more than offsets the initial cost difference. Moreover, in projects where a reduced thickness of RAC is feasible, the actual amount of material is reduced, thus lowering the effective cost of RAC. Despite data demonstrating these cost benefit factors, our survey confirms that many local agency stakeholders still retain the belief that RAC is not cost beneficial. Specifically, when asked what the State can do to promote the use of RAC, the largest group (51 percent) indicated that the state should make RAC more cost effective.

The actual total project cost of RAC may actually be less than AC when two important factors are considered: first, some RAC applications require less material; and second, RAC projects have longer life cycles than AC. For example, both Technology Centers agree that the Caltrans Design Guidelines for a Reduced Thickness Overlay allows local agencies to use less RAC in these projects than AC; thus reducing the amount of product and the total cost. It should be noted that the Caltrans Design Guidelines prescribes that only Wet Process RAC can be used for the Reduced Thickness Overlay projects.

Additionally, the vast majority of pavement studies show that RAC has a significantly longer project life span than AC. Reflective cracking, a significant problem in AC, is virtually non-existent in RAC projects. Studies of projects completed in the cities of Ventura and Burbank over the last ten years support the extended life and the resistance to reflective cracking of RAC applications.

Another issue surfaced during our discussions with one of the Technology Centers is the possible reluctance of local officials to approve RAC projects fearing the potential political fallout should the project fail. Despite more than 35 years of successful utilization, some local government agencies still see RAC as an untested, experimental product. Due to this perception, some local government officials choose to use AC over RAC to avoid any political controversy should a paving project fail to perform as expected. Several of the respondents to our survey recommended that the State provide inspection workshops or inspectors for RAC projects to ensure their success.

Current Incentive Programs Do Not Effectively Entice Potential RAC Users

To encourage RAC usage and to offset the difference in cost per ton for the material, the Board approved two incentive programs. Since the introduction of these programs over four years ago, few local agencies have taken advantage of these incentives. Only 17 percent of our respondents participated in a RAC incentive program, and 88 percent of our survey respondents participating in RAC projects indicated that the incentive programs had no influence on their use of RAC. Further, when asked what the State can do to encourage RAC usage, a large number indicated the need for greater incentive payments, rebates, and grants. With the enactment of Senate Bill 1246 (Chapter 671, Statutes of 2002), it is unclear whether the increase of incentive payments to $2.50 per ton will be sufficient to impact the incentive program and stimulate increased use of RAC.

The Quality Assurance/Quality Control (QA/QC) rebate program was introduced as a way to offset some of the price differential between RAC and AC, and also to ensure the success of projects by having outside engineers analyze the project to verify that the RAC had been properly applied. This program was deemed necessary due to high profile project failures in the mid-1990's due to improperly applied RAC. Initially, the Board offered a rebate of $1.00 per ton up to a maximum of $10,000 per project that was later increased to $1.25 per ton with a per project maximum of $12,500. Anecdotal comments by stakeholders suggested that the low rebate combined with the cost of the quality assurance requirement rendered the incentive unattractive and not cost beneficial. SB 1346, although unrelated to the QA/QC program, doubles the amount of rebate per ton to $2.50 and quadruples the project maximum to $50,000.

The second incentive program, the Pavement Deflection Test, was intended to entice testing RAC to determine feasibility of using the material for a particular project and also to determine whether a Reduced Thickness Overlay (thus reducing the amount of

material needed) is suitable for the project. The incentive offered up to $5,000 to conduct a Pavement Deflection Test. Finding that the project was not meeting its expectations, the Southern Technology Center discontinued this incentive program in December 2001.

Thirty-five percent of our survey respondents answering the question indicated that they had not participated in incentive programs because of lack of awareness. Interestingly, contrary to other information, few cited the quality control or lack of cost benefit of the rebate program to be a reason for not utilizing the program.

We asked the Technology Centers, the Board, RAC producers and consultants for contacts in other states active in RAC usage to identify other state programs offering incentives. Only South Carolina appears to have a program similar to those in California. Specifically, South Carolina established a partnership between the Department of Health and Environmental Control, Clemson University, and the City of Clemson. This partnership created the Asphalt Rubber Technology Service for South Carolina (ARTS). The ARTS program was created for promoting, designing, and testing of RAC. Currently, ARTS is completing the third-year of a five-year plan. South Carolina assesses a $2.00 per tire fee on new tire purchases. From this fee, about $0.44 is placed in the South Carolina Waste Tire Trust Fund that is used for grants, research, and promotion of the ARTS program. According to the ARTS staff, the total allocation to ARTS is approximately $1 million per a year for each of the program's five years. Additionally, the ARTS program leased an Asphalt Rubber Blending Unit to help reduce the price differential for RAC over conventional asphalt concrete.

Imported RAC Raw Materials May Minimize Benefits to California's Solid Waste Stream

During our review, we found that some California crumb rubber producers use tires imported from other states and countries. With California generating over 33 million scrap tires annually the import and use of tires from out of the state could negate RAC and other recycling efforts the Board sponsors. Studies indicate that between two and three million tires are imported from other states, with additional tires imported from other countries, such as Canada and Mexico. Approximately two million tires currently sit in legal and illegal scrap tire piles throughout California. Stakeholders indicate that the import of tires is economical and that imported materials are cheaper than those generated within the state. We did not verify this contention; however, while recycling tires from any source benefits the public as a whole, the State may want to consider whether it should establish a priority to use California scrap tires first for recycling programs. Current estimates project that by 2020 California will generate over 43 million waste tires per year.

The Board and Caltrans recently agreed to a RAC "Process Comparison Test" outside of Fresno (District 6 – Firebaugh). As part of the Process Comparison Test, Caltrans must use crumb rubber from California tires. A report released by the California Senate Advisory Commission on Cost Control in November 2003 conveys that the State of

Arizona instituted a requirement for Arizona Department of Transportation RAC projects to use only crumb rubber generated from Arizona tires.

Recommendations

The Board should consider:

- Examining the delivery method of the Technology Centers and consider the use of full time individuals who can proactively work with local officials, Board staff, and other stakeholders.
- Continuing to support Technology Centers' efforts to develop RAC performance and cost data that will provide local jurisdictions evidence of the costs and benefits of using RAC.
- Continuing to enhance incentives and rebate programs for using RAC.
- Developing a program to either train local authorities to inspect RAC projects or provide inspection services to local jurisdictions to ensure the proper application of RAC and the success of projects.
- Collaborating with producers to make RAC more available and affordable.
- Assisting the Technology Centers in developing a collaborative relationship with Caltrans and for leveraging the State's position in making RAC more available and attractive to public works authorities.
- Establishing guidelines and incentives for RAC producers and users to use only California tires for their crumb mixes.

Appendix A. Technology Center Survey Results

As described in Chapter 1 of our report, in September 2003, Sjoberg-Evashenk created a board-approved survey consisting of 39 questions regarding the services provided by the two Technology Centers in California. We first developed a database identifying nearly 1,000 RAC stakeholders. After reviewing the listing and eliminating those with insufficient contact information, we selected a total of 902 local agency managers, RAC producers, contractors, and consultants to participate. Our survey is Internet based and was distributed primarily though e-mail—we e-mailed 746 surveys and faxed 156. The initial response to our survey after two weeks was very low from the e-mailed group but was adequate from the facsimile group. Therefore, we sent the e-mail surveys a second time with a different cover to all 746 recipients, with a request to return the survey within two weeks.

Again, we received a very small response. We then chose to directly contact a few individuals in our e-mail group and we discovered that due to recent Internet problems with viruses and spam, many individuals no longer open documents from unknown sources. Therefore, we went through the arduous process of obtaining fax numbers and faxing another 100 surveys to recipients in our e-mail group. Ultimately, after many attempts, we achieved a 16 percent response rate to our survey. Results of our survey can be found in Appendix A. We ultimately removed from our survey results 28 responses from producers, contractors, and consultants to limit our data to local agencies—the target audience of the Technology Centers, which resulted in 115 responses or a 13 percent final response rate from 874 invitations to participate. Our survey, results, and comments are provided in the following pages.

Technology Center Survey Results

1. What segment of the pavement industry do you represent?	Number of Responses	Response Ratio
End User (City, County or Special District)	115	100%
Producer	0	0%
Contractor	0	0%
Consultant	0	0%
Other	3	3%

2. If you represent an End-User (local government), what is your population size?	Number of Responses	Response Ratio
Small (<25,000)	27	23%
Medium (25,000-100,000)	49	43%
Large (>100,000)	38	33%
Not Applicable	1	1%

3. Where are you geographically located?	Number of Responses	Response Ratio
Northern California (The Counties of Monterey, Kings, Tulare, Inyo and points North)	56	49%
Southern California (The Counties of San Luis Obispo, Kern, San Bernardino, and points South)	59	51%

4. What is your Zipcode?

VIEW 112 Responses

5. Are you familiar with Rubberized Asphalt Concrete (RAC)? If no, skip to question #8.	Number of Responses	Response Ratio
Yes	106	92%
No	9	8%

Technology Center Survey Results

6. How did you become familiar with Rubberized Asphalt Concrete (RAC)?	Number of Responses	Response Ratio
Involved with a RAC project	60	57%
Read about the material in a journal or other literature	46	43%
Heard about it through peers or colleagues	38	36%
Attended a presentation or panel where the material was discussed	37	35%
Other	7	7%

7. On a scale of 1 to 5 (1 - remotely familiar and 5 - very familiar), how would you rate your familiarity with RAC?	Number of Responses	Response Ratio
Remotely Familiar 1.	9	9%
2.	18	17%
3.	26	25%
4.	36	34%
Very familiar 5.	16	15%
Total	105	100%

8. Have you or your organization constructed a project involving RAC? If no, skip to question #11.	Number of Responses	Response Ratio
Yes	67	59%
No	46	41%

9. If you answered "Yes" to the previous question, please note the project location(s) and date(s) of completion.

VIEW 63 Responses

Technology Center Survey Results

10. If you participated in a RAC project, what type of project was it?	Number of Responses	Response Ratio
	3	4%
Test	3	4%
Regular roadway construction (rehabilitation or maintenance)	66	96%
Other	0	0%

11. Are you familiar with California's Rubberized Asphalt Concrete Technology Centers (RACTCs)?	Number of Responses	Response Ratio
Yes	47	41%
No	68	59%

12. Are you familiar with the services that the RACTCs provide?	Number of Responses	Response Ratio
Yes	32	28%
No	82	72%

13. Have you had any contact with the RACTCs?	Number of Responses	Response Ratio
Yes	33	29%
No (please skip to question #21)	80	71%

14. How did you learn about the RACTCs? Please select from the following:	Number of Responses	Response Ratio
Internet	1	3%
Workshop/Seminar	18	49%
RACTC Brochure	18	49%
Referred by an organization that knew of the RACTC	7	19%
Other	8	22%

Technology Center Survey Results

15. Did you or your organization initiate the contact (versus RACTC initiating contact)?	Number of Responses	Response Ratio
Yes	16	42%
No	22	58%

16. What method of contact did you use? Please select.	Number of Responses	Response Ratio
Phone	15	48%
Email	3	10%
Letter	7	23%
Approached at a workshop/seminar	10	32%
Other	3	10%

17. How quickly did RACTC respond to your inquiry(ies)? Please select from the following choices.	Number of Responses	Response Ratio
Immediately	12	46%
1-3 working days	6	23%
4-6 working days	4	15%
7-14 working days	3	12%
More than 14 working days	0	0%
Never	1	4%

18. What type of assistance or information did you request from the RACTC?	Number of Responses	Response Ratio
General Information/Assistance	20	59%
Incentive Information/Assistance	13	38%
Project Specific Information/Assistance	7	21%
Program Specific Information/Assistance	2	6%
Other	2	6%

Technology Center Survey Results

	On a scale of 1 to 5 (1 - not very helpful and 5 - very helpful), how would you rate the RACTC assistance you received?	Number of Responses	Response Ratio
Not very helpful	1.	0	0%
	2.	2	6%
	3.	4	13%
	4.	11	34%
Very Helpful	5.	14	44%
N/A, no contact with RACTCs	6.	1	3%
	Total	32	100%

20.	On a scale of 1 to 5 (1 - minimally knowledgeable and 5 - very knowledgeable) how would you rate the depth of knowledge conveyed by the RACTC staff providing you assistance?	Number of Responses	Response Ratio
Minimally knowledgeable	1.	0	0%
	2.	1	3%
	3.	1	3%
	4.	15	47%
Very knowledgeable	5.	12	38%
N/A, no contact with RACTCs	6.	3	9%
	Total	32	100%

21.	Have you ever attended a workshop that related to or provided information about RAC?	Number of Responses	Response Ratio
Yes		56	51%
If "No", please skip to question #25.		54	49%

22. If you answered "Yes" to the previous question, what was the date and location of the workshop(s)?

VIEW 49 Responses

Technology Center Survey Results

23. If you answered "Yes" to question #21, what was the format of the RAC information? Indicate all that apply.	Number of Responses	Response Ratio
Kiosk	1	2%
Panel	6	11%
Session presentation	48	89%
Casual conversation	7	13%
Pamphlets, brochures, other informative materials	25	46%
Other	2	4%

24. If you answered "Yes" to question #21, on a scale of 1 - 5 (1- Not Useful 5 - Very Useful), how useful was the information discussed or provided during the workshop in meeting your needs regarding RAC?	Number of Responses	Response Ratio
Not Useful 1.	0	0%
2.	4	7%
3.	15	27%
4.	21	38%
Very Useful 5.	15	27%
Total	55	100%

25. If you have previously used RAC on a project, have you done so in the last three years?	Number of Responses	Response Ratio
Yes	54	52%
No	49	48%

26. How many RAC projects did you initiate that were a direct result of the information and efforts provided to you by the RACTC?

VIEW 72 Responses

Technology Center Survey Results

27. Have you participated in the RACTC rebate program?	Number of Responses	Response Ratio
Yes	18	17%
No	89	83%

28. If "No" to the previous question, what prevented you from participating in the RACTC rebate program?	Number of Responses	Response Ratio
Overall Cost of RAC	18	23%
Incentive Rebate was cost prohibitive	3	4%
My agency was not eligible for the rebate	7	9%
Rebate was rejected due to Quality Assurance/Quality Control	1	1%
VIEW Other, Please Specify	52	65%

29. In your opinion, which of the following two rebate programs provides the greatest incentive to use RAC?	Number of Responses	Response Ratio
Pavement Deflection Testing – Provide full cost of the deflection study (Allows the engineer to compare the thickness, the cost and the lifespan of an overlay project.)	15	18%
Quality Assurance/Quality Control – Tonnage incentive for plant inspection and job site inspection (Current reimbursement is $1.25 per a ton, up to $12,500 per a project, soon to be increased to $2.50 per a ton, up to $50,000 per project)	70	84%

30. Did information or incentive programs sponsored by the RACTCs directly influence RAC projects you initiated?	Number of Responses	Response Ratio
Yes	11	12%
No	84	88%

Technology Center Survey Results

	If you answered "Yes" to the previous question, please rate on a scale of 1 to 5 (1 - little influence and 5 - strong influence) the influence of RACTCs on conducting RAC projects.	Number of Responses	Response Ratio
Little influence	1.	1	7%
	2.	0	0%
	3.	4	29%
	4.	9	64%
Strong influence	5.	0	0%
	Total	14	100%

32.	Have you ever visited the RACTC website? (www.ruberizedasphalt.org)	Number of Responses	Response Ratio
	Yes	18	16%
If No, please skip to question #37.		97	84%

33.	If you answered "Yes" to the previous question, did you find the website to be easy to locate and navigate?	Number of Responses	Response Ratio
	Yes	18	90%
	No	2	10%

34.	If you answered "Yes" to question #32, what could be added to improve the services and information contained on the website?
	VIEW 4 Responses

Technology Center Survey Results

35. If you answered "Yes" to question #32, have you reviewed any results of research projects funded by RACTC's on the website?	Number of Responses	Response Ratio
Yes	4	
No	11	73%

36. If you answered "Yes" to the previous question, on a scale of 1 to 5 (1 - minimally informative and 5 - very informative) how would you rate the information provided in the research studies?		Number of Responses	Response Ratio
Minimally informative	1.	0	0%
	2.	0	0%
	3.	2	29%
	4.	4	57%
Very informative	5.	1	14%
	Total	7	100%

37. On a scale of 1 – 5 (1 - little or no importance 5 - highly or significantly important) please rank the following benefits of using RAC for resurfacing:

The top percentage indicates total respondent ratio; the bottom number represents actual number of respondents selecting the option	1 No importance	2 Minimally important	3 Important	4 Moderately important	5 Highly important
1. Provides long-lasting durability	1% 1	1% 1	13% 13	30% 30	55% 54
2. Resists reflective cracking, rutting, and shoving	0% 0	0% 0	15% 15	41% 41	43% 43
3. Provides a skid resistant surface	1% 1	7% 7	40% 39	32% 31	20% 19
4. Excellent color contrast for striping and marking	4% 4	14% 14	29% 28	32% 31	21% 20
5. Reduces tire noise	2% 2	11% 11	21% 21	37% 36	29% 28
6. Reduced overlay thickness	2% 2	14% 13	14% 13	34% 33	36% 35

Technology Center Survey Results

38.	What more can the State do to promote the use of RAC?

VIEW 55 Responses

39.	If you would like to be contacted by the RACTC to expand on or explain your response, or to generally discuss rubberized asphalt concrete applications, please provide a contact name and phone or e-mail address below:

VIEW 115 Responses

Appendix B. Selected Comments From Survey Respondents

In Question 38 of our survey to local agency RAC stakeholders, we requested that respondents provide suggestions for the State to increase the usage of RAC in California. A total of 55 individuals answered our question and their responses are listed on the following section.

Comments from Selected Survey Respondents

38 What more can the State do to promote the use of RAC?

#	Response
1	Provide funding to cover the extra cost.
2	Get local batch plants to produce it. Get consulting engineers to specify it.
3	Don't know at this point.
4	Identify what, if any, problems are presented in disposing of the grindings from a RAC project in the future.
5	Establish programs to make it more readily available outside major urban areas.
6	Provide more money incentives. Defer the cost down to the price of regular asphalt, about $10 per ton.
7	Make agencies aware of rebate programs. Get end users to provide case studies and reports to be published.
8	Give incentives to asphalt plants to provide RAC capability.
9	Put out more contracts using material to increase competition and reduce price.
10	Make it cost effective.
11	Educate the contractors and engineering consultants.
12	More rebates
13	Help train agency inspectors for proper installation or RAC
14	Provide demos and lists of projects where application has been applied, as well as verifable application dates.
15	Life cycle analysis.
16	Advertise any grants that would offset the price.
17	Continue research to refine appropriate use. Projects I have observed have serious problems, dishing, pushing, rutting overlays, bleed-through of dark stains (metals/oils?) into pavement striping.
18	Reasonably priced seminars in local areas (Santa Rosa, Eureka, Sacramento, Vallejo, Napa - all driveable). Literature.
19	Cost, cost, cost. The obvious benefit is when delivering a section which can be reduced by one-half thereby creating cost effectiveness. I would really like to not have to be as concerned about cost and prescribe RAC all of the time.
20	RAC may not be promoted on the coast due to unfavorable placing conditions.
21	Contact the Engineering Associations and SWANA. Speak directly to the Public Works Directors and Deputies in their working environments
22	More information sent to Cities.
23	Keep the educational program on the benefits of RAC at or greater than the level it is now
24	Buy down cost t make it more competitive with conventional A.C.
25	Increase Grant funding
26	Help provide specification writing & understanding to cities without large engineering staff.
27	Inspection workshops
28	Specifications, test results, and incentives
29	Availability of RAC Bring down costs with more rebates
30	more education on the subject with better incentives.
31	Lower the cost by setting up standard specifications (including QC/QA procedures) allowing greater market penetration to increase supplier competition.
32	State funding incentive/reimbursement
33	Solicit agencies directly-

Comments from Selected Survey Respondents

34	Offer full-time inspection and long term warranty on R.A.C.
35	Funding for demonstration projects, rebates
36	Notify when incentives are being funded.
37	Cost is an issue, needs to be closer in price to conventional asphalt.
38	No comment
39	Quit gutting our grant funding so we can begin completing our rehab projects.
40	The majority of Claremont's overlays are 1.2 If RAC could be placed at less than 2 it would be used more often.
41	Bradbury is a very small City and we have not done any paving in 3 years. I will contact website for more information.
42	Coordinate w/plants to offer the material at a reasonable cost.
43	Increasing the grant amount is a good idea.
44	Better financial incentive to using the product.
45	More funding incentives/rebates.
46	Specifying what is benefit of RAC (more or less expensive than conventional AC); On what kid subgrade? or on what kind of existing pavement can RAC be used for overlay? Any savings? Any grants? etc..
47	Give more money toward the cost of the projects that will allow smaller projects to be feasible.
48	$$ incentives
49	Follow through on providing $$ when an agency requests it in the incentive program.
50	Distribute more literature to local agencies.
51	Subsidize its use with grants and deep discounts for material.
52	Increase number of asphalt plans and quality QC/QA
53	Seminars and workshops
54	The State can assist contractors/plant operators with setting-up plants for RAC. In previous years we were limited to asphalt "runs" of twice a year-this is too restrictive. How can RAC become more available?
55	Better incentives

Appendix C. Outreach Materials Survey Results

As described in Chapter 1 of our report, Sjoberg Evashenk created a second set of surveys to assess the usefulness and adequacy of the information presented in the Technology Centers' educational and informational materials to ascertain whether the documents motivate local government to consider using RAC and provide the appropriate level of information and detail. We created two survey documents: one to assess the Rubberized Asphalt Concrete Technology Center "overview" booklet; and a second to evaluate the more technical *Asphalt Rubber Design and Construction Guideline* booklet. We identified 25 respondents to our original survey of Technology Center services who agreed to conduct the documentary review. Ultimately, we received completed surveys from 12 of those individuals selected—the results follow.

Outreach Materials Survey Results

1. Have you reviewed either of these materials previously?		Number of Responses	Response Ratio
Brochure "A" Yes		2	20%
		8	80%
		3	30%
		7	70%

Brochure "A" is intended to provide a general overview of RAC material. Please rank the following statements, 1-5.

The top percentage indicates total respondent ratio; the bottom number represents actual number of respondents selecting the option	1 Do Not Agree	2	3 Agree	4	5 Fully Agree
entire booklet.	0% 0	8% 1	8% 1	67% 8	17% 2
2. b. The level of information is sufficient, useful.	0% 0	0% 0	17% 2	58% 7	25% 3
3. c. The pamphlet fully explains the roles of the RAC Technical Centers	8% 1	17% 2	25% 3	42% 5	8% 1

3. How would you rank the clarity of the information and usefulness of the presentation with "1" representing "Not useful or Not clear" and "5" representing "Very useful or Very clear" in the following areas:

The top percentage indicates total respondent ratio; the bottom number represents actual number of respondents selecting the option	1 Not Useful or Not clear	2	3 Useful or Clear	4	5 Very Useful or Very Clear
1. a. The listing of Rubberized Asphalt Products.	0% 0	0% 0	17% 2	67% 8	17% 2
2. b. History of Rubberized Asphalt Concrete (RAC)	0% 0	0% 0	25% 3	42% 5	33% 4
3. c. Processes used to manufacture RAC.	0% 0	0% 0	17% 2	50% 6	33% 4
4. d. Frequently Asked Questions about RAC.	0% 0	0% 0	17% 2	67% 8	17% 2
5. e. Project applications.	0% 0	0% 0	45% 5	36% 4	18% 2
6. f. The cost of RAC vs. conventional asphalt concrete.	0% 0	17% 2	8% 1	67% 8	8% 1
7. g. Bid price history for the Counties of Los Angeles and Sacramento.	0% 0	9% 1	27% 3	36% 4	27% 3

Outreach Materials Survey Results

4.	Is the level of information and the presentations of the pamphlet compelling to inspire the use of RAC or find out more about RAC?				
The top percentage indicates total respondent ratio; the bottom number represents actual number of respondents selecting the option	1 Not Compelling or Uninspiring	2	3 Compelling or Inspiring	4	5 Very Compelling or Very Inspiring
	0% 0	0% 0	25% 3	50% 6	25% 3

Outreach Materials Survey Results

1. Section 1.0 - Introduction/ Please review the brochure section by section and fill out the following matrix using a 1 to 5 rating scale with "5" representing Excellent and "1" being Needs Improvement.

The top percentage indicates total respondent ratio; the bottom number represents actual number of respondents selecting the option		2	3 Good	4	5 Excellent
1. a. Information adequate	0% 0	0% 0	25% 3	50% 6	25% 3
2. b. Appropriate technical detail	0% 0	0% 0	8% 1	75% 9	17% 2
3. c. Usefulness of information presented	0% 0	0% 0	17% 2	58% 7	25% 3

2. Section 2.0 - Asphalt Rubber

The top percentage indicates total respondent ratio; the bottom number represents actual number of respondents selecting the option	1 Needs Improvement	2	3 Good	4	5 Excellent
1. a. Information adequate	0% 0	0% 0	17% 2	42% 5	42% 5
2. b. Appropriate technical detail	0% 0	0% 0	8% 1	58% 7	33% 4
3. c. Usefulness of information presented	0% 0	0% 0	17% 2	58% 7	25% 3

3. Section 3.0 - Asphalt Rubber Design Considerations

The top percentage indicates total respondent ratio; the bottom number represents actual number of respondents selecting the option	1 Needs Improvement	2	3 Good	4	5 Excellent
1. a. Information adequate	0% 0	0% 0	17% 2	58% 7	25% 3
2. b. Appropriate technical detail	0% 0	0% 0	17% 2	58% 7	25% 3
3. c. Usefulness of information presented	0% 0	0% 0	8% 1	42% 5	50% 6

4. Section 4.0 - Asphalt Rubber Material Issues

The top percentage indicates total respondent ratio; the bottom number represents actual number of respondents selecting the option	1 Needs Improvement	2	3 Good	4	5 Excellent
1. a. Information adequate	0% 0	0% 0	8% 1	50% 6	42% 5

Outreach Materials Survey Results

2. b. Appropriate technical detail	0% 0	0% 0	8% 1	50% 6	42% 5
3. c. Usefulness of information presented	0% 0	0% 0	8% 1	42% 5	50% 6

5. Section 5.0 - Asphalt Rubber Construction Issues - ARHM

The top percentage indicates total respondent ratio; the bottom number represents actual number of respondents selecting the option	1 Needs Improvement	2	3 Good	4	5 Excellent
1. a. Information adequate	0% 0	0% 0	9% 1	64% 7	27% 3
2. b. Appropriate technical detail	0% 0	0% 0	9% 1	55% 6	36% 4
3. c. Usefulness of information presented	0% 0	0% 0	0% 0	55% 6	45% 5

6. Section 6.0 - Asphalt Rubber Construction Issues - Chip Seals

The top percentage indicates total respondent ratio; the bottom number represents actual number of respondents selecting the option	1 Needs Improvement	2	3 Good	4	5 Excellent
1. a. Information adequate	0% 0	0% 0	0% 0	82% 9	18% 2
2. b. Appropriate technical detail	0% 0	0% 0	0% 0	64% 7	36% 4
3. c. Usefulness of information presented	0% 0	0% 0	0% 0	73% 8	27% 3

7. Section 7.0 - Pre-Construction Meeting

The top percentage indicates total respondent ratio; the bottom number represents actual number of respondents selecting the option	1 Needs Improvement	2	3 Good	4	5 Excellent
1. a. Information adequate	0% 0	0% 0	27% 3	55% 6	18% 2
2. b. Appropriate technical detail	0% 0	0% 0	18% 2	64% 7	18% 2
3. c. Usefulness of information presented	0% 0	0% 0	36% 4	27% 3	36% 4

Outreach Materials Survey Results

8. Section 8.0 - Environmental Considerations

The top percentage indicates total respondent ratio; the bottom number represents actual number of respondents selecting the option	1 Needs Improvement	2	3 Good	4	5 Excellent
	0% 0	0% 0	27% 3	36% 4	36% 4
2. b. Appropriate technical detail	0% 0	 0	 3	45% 5	27% 3
	0% 0	9% 1	27% 3	45% 5	18% 2

9. Section 9.0 - Current/Future Developments

The top percentage indicates total respondent ratio; the bottom number represents actual number of respondents selecting the option	1 Needs Improvement	2	3 Good	4	5 Excellent
1. a. Information adequate	0% 0	0% 0	30% 3	50% 5	20% 2
2. b. Appropriate technical detail	0% 0	0% 0	40% 4	50% 5	10% 1
3. c. Usefulness of information presented	0% 0	0% 0	40% 4	40% 4	20% 2

Appendix D. Crosswalk of Objectives to Report Sections

Contractor Responsibilities per Statement of Work	Report Reference
Task 1: Review documents that contain the criteria against which these programs will be measured, and develop the evaluation methodology (pre-evaluation phase).	**Scope and Methodology Pages 12-13**
• Research all relevant documents pertaining to the criteria against which the RACTCs will be measured	**Pages 12-13**
• Conduct informational interviews with relevant CIWMB staff, RACTC staff, clients and stakeholders, such as RAC producers in California	**Pages 12-13**
• Develop a methodology for conducting both process and outcomes-based evaluations	**Pages 12-13**
• Prepare a draft chapter for the final report presenting the background of the development of the RACTCs, the criteria against which to measure the RACTC's processes and outcomes, and a methodology for the evaluations	**Background** **Pages 6-12**
• Develop a contact list of stakeholders relevant to the use of RAC in local government pavement projects	**Separate Document**
Task 2: Conduct and distribute a survey of local government transportation departments to determine their knowledge and perceptions of RAC, their needs regarding expertise in RAC, and appropriate incentives or assistance that will encourage them to use RAC in pavement projects.	**Scope and Methodology Pages 12-13**
• Analyze survey results and prepare data summaries	**Ch. 1-Pg. 14, Appendices A to C**
• Use information from the survey to identify issues and provide recommendations to the CIWMB and to both RACTCs	**Ch. 1-Pages 26-27** **Ch. 2-Pg. 32**
• Prepare draft chapter on survey results.	**Chapter 1**
Task 3: Review and document allocations of funds and funds expended by the two RACTCs during the entire history of the centers.	**Ch. 1-Pg. 25** **Scope and Methodology Pages 12-13**
• Review allocations, invoices and reports from the RACTCs	**Ch. 1-Pg. 25** **Scope and Methodology Pages 12-13**
• Compare allocations to total expenditures for each contract	**Ch. 1-Pg. 25** **Scope and Methodology Pages 12-13**
• Through analysis of the allocations and expenditures, interviews and other means, determine if and why funds were unspent	**Ch. 1-Pg. 25** **Scope and Methodology Pages 12-13**

• Examine resources used by the RACTCs to accomplish program goals and objectives	**Ch. 1-Pg. 25** **Scope and Methodology Pages 12-13**
• Develop a cost analysis of categories of expenses based on allowable costs and determined by the provisions of the contracts	**Ch. 1-Pg. 25** **Scope and Methodology Pages 12-13**
• Prepare a draft analysis and summary of allocations and costs as a chapter for the final report	**Chapter 1**
Task 4: Perform a process evaluation of the two RACTCs	**Chapters 1 & 2**
• Examine the processes and determine if there are any systemic difficulties that the RACTCs face in implementing the programs	**Chapter 1- Pages 18-23** **Chapter 2**
• Determine if the RACTCs are creating any tangible process changes in the way local governments view RAC or consider its use in their paving projects	**Chapter 1** **Appendices A-C**
• Identify the activities and outreach materials the RACTCs use to accomplish the goals and objectives of the programs	**Chapter 1 Pages 14-18**
• Based on the criteria in Task 1 and information gathered for the process evaluations; determine if the RACTCs are successfully implementing the programs	**Chapter 1**
• Provide recommendations for improved processes or methods to accomplish the goals and objectives of the program	**Chapter 1- Pages 26-27**
Task 5: Perform an outcomes-based evaluation of the two RACTCs.	**Chapter 1** **Appendices A-C**
• Examine what has changed in the county or State as a result of these two RACTCs	**Chapter 1** **Appendices A-C**
• Look at the effectiveness of the outreach materials used	**Chapter 1- Page16** **Appendix B**
• Determine if the data maintained by the RACTCs reflect and measure program successes in terms of the goals and objectives set for the programs	**Chapter 1- Pages 23-25**
• Evaluate the program outcomes in terms of the resources expended, as determined in Task 3	**Chapter 1**
• Review and evaluate internal evaluation measures used by the RACTCs to measure success	**Chapter 1- Pages 23-25**

• Prepare recommendations to both RACTCs and to the CIWMB to improve program outcomes	**Chapter 1- Page 26-27** **Chapter 2- Page 32**
Task 6: Prepare a draft and a final report and provide copies to the CIMWB.	**Report**
Task 7: Present information from tasks, findings, and recommendations to the CIWMB at Board Meetings and subsequently at workshops and/or Waste Tire Conferences.	**To be developed**